

PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Fast-Neutron Detector.

We, MAGYAR TUDOMANYOS AKADEMIA KOZPONTI FIZIKAI KUTATO INTEZETE, an Hungarian Body Corporate, of Konkoly Thege ut, Budapest XII, Hungary, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to fast neutron detectors employing the scintillation principle, which have a scintillator consisting of a mixture of zinc sulphide activated with silver and of a substance having a high hydrogen content.

It is known that fast neutrons can be detected by the scintillation method using the phenomenon of proton recoil. In order to make use of this phenomenon, two substances must be present:

(A) a substance having a high hydrogen content and

(B) a scintillating substance.

Mixtures of these two substances are well suited to detecting fast neutrons using the scintillation principle.

At present, two variations of the scintillating fast neutron detector are known, the so-called Hornyak type and the so-called Emmerich type. The Hornyak type uses a mixture of the substance having a high hydrogen content and of the scintillating substance. The Emmerich type is similar but the mixture is arranged in a light-guide system formed from a transparent synthetic material (e.g. from Plexiglas, registered Trade Mark) by milling or turning. Previously proposed detectors have invariably employed a scintillating substance consisting of zinc sulphide activated with silver, the substance having a high hydrogen content being paraffin or some transparent synthetic material, e.g. polyvinyl toluene. Of the two detectors, the

Emmerich type has been more commonly used due to its better efficiency.

The present invention is based on the recognition that the efficiency of a fast-neutron detector depends to a greater extent on the hydrogen content of the hydrogen containing substance than on the amount of light recorded from each scintillation, viz: on the transparency of the substance having a high hydrogen content. Therefore it is not absolutely necessary that the substance having a high hydrogen content be completely transparent. The light yield and hence also the efficiency, were undoubtedly improved by employing compounds such as polyvinyl toluene in place of paraffin, but at the same time the specific hydrogen content was decreased.

According to the present invention therefore there is provided a fast neutron detector of the type having a plurality of annular light-guides embedded in a mixture of a substance having a high hydrogen content and a scintillating substance, wherein the substance having a high hydrogen content is polyethylene and the scintillator is silver activated zinc sulphide.

In the fast neutron detector of the invention, the zinc sulphide activated with silver is employed, depending on the shape of the scintillator, in an amount ranging from 10 to 40% by weight based on the weight of polyethylene.

The use of polyethylene in place of paraffin is particularly advantageous from the point of mechanical strength.

Previously, when using a weak substance such as paraffin to support the zinc sulphide activated with silver it has been necessary to introduce the substances into a solid light guide ring system which served at the same time to mechanically support the substances (A) and (B). The light-guide system is in-

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active from the point of view of detection, consequently, this light guide system while giving a better and more efficient light yield could not be used for detecting reactions.

- 5 In the detector of the invention, polyethylene is used in the active part of the detector and functions at the same time as to give the detector strength, viz. the polyethylene is self-supporting and also supports the light-guide. Consequently, in detectors according to the invention it is possible to employ a concentric ring system in which the exterior ring is active, the following ring inactive and the subsequent ring again active etc., as contrasted with the inactive-active-inactive etc. arrangement previously employed. Thus for a given diameter, an optimum of active mass and an optimum of light-guide materials can be employed. Both 20 the efficiency and the light-yield are thereby improved, this being particularly the case with detectors having diameters of not more than 50 mm.

- 25 Detectors according to the invention have resulted in increased efficiencies of up to 30 to 50 %, depending on the diameter of the detector. Polyethylene has the advantages of being cheap and more easily worked than polyvinyl toluene since injection moulding can be used as opposed to milling or turning. 30

WHAT WE CLAIM IS:—

1. A fast neutron detector of the type having a plurality of annular light-guides embedded in a mixture of a substance having a high hydrogen content and a scintillating substance, wherein the substance having a high hydrogen content is polyethylene and the scintillator is silver activated zinc sulphide. 35
2. A detector as claimed in claim 1 containing from 10 to 40% by weight of silver activated zinc sulphide based on the weight of polyethylene. 40
3. A detector as claimed in claim 1 or claim 2, having an exterior annular ring of said mixture of a substance having a high hydrogen content and a scintillating substance. 45
4. A detector as claimed in any one of the preceding claims in which said mixture is self-supporting and also supports the light-guides. 50
5. A fast neutron detector as claimed in claim 1 substantially as herein described.

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